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Ogyu

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(54) **GRINDER AND GRINDING MACHINE**

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CPC ***B24B 7/224*** (2013.01)

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CPC B24B 7/244; B24B 45/00; B24B 41/047
USPC 451/280, 271, 272, 278, 353
See application file for complete search history.

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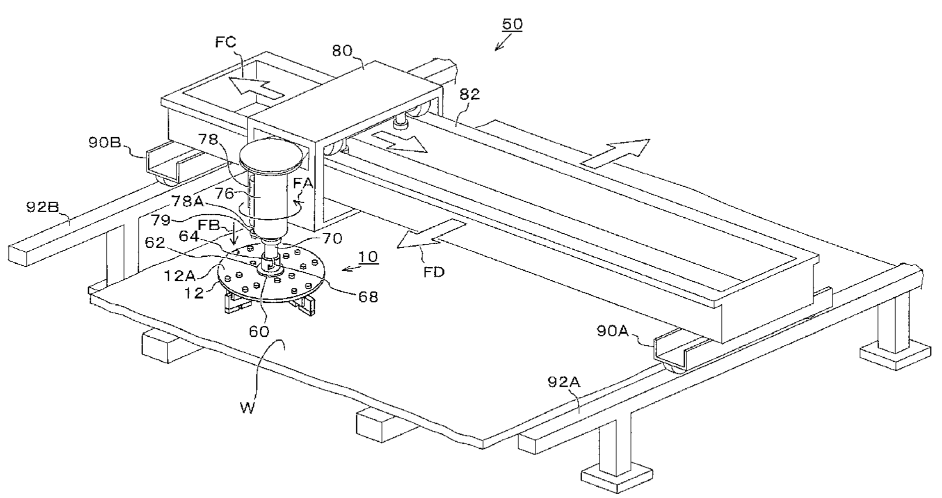
(57) **ABSTRACT**

A grinder includes a rotatable disk to be pressed to a workpiece; a plurality of grinding bodies provided on one principal surface of the disk so as to cross a circumferential direction of the disk, each having a grinding stone chip on a side contacting the workpiece; and support devices, each supporting each of the grinding bodies so that the grinding stone chip swings with respect to the principal surface. Each support device supports each grinding body at a position at which an abrasion amount of the grinding stone chip is made uniform when the disk is rotated while being pressed to the workpiece so that a pressure to be applied to the grinding stone chip on an outer peripheral side of the disk becomes smaller than a pressure to be applied to the grinding stone chip on an inner peripheral side of the disk.

11 Claims, 4 Drawing Sheets



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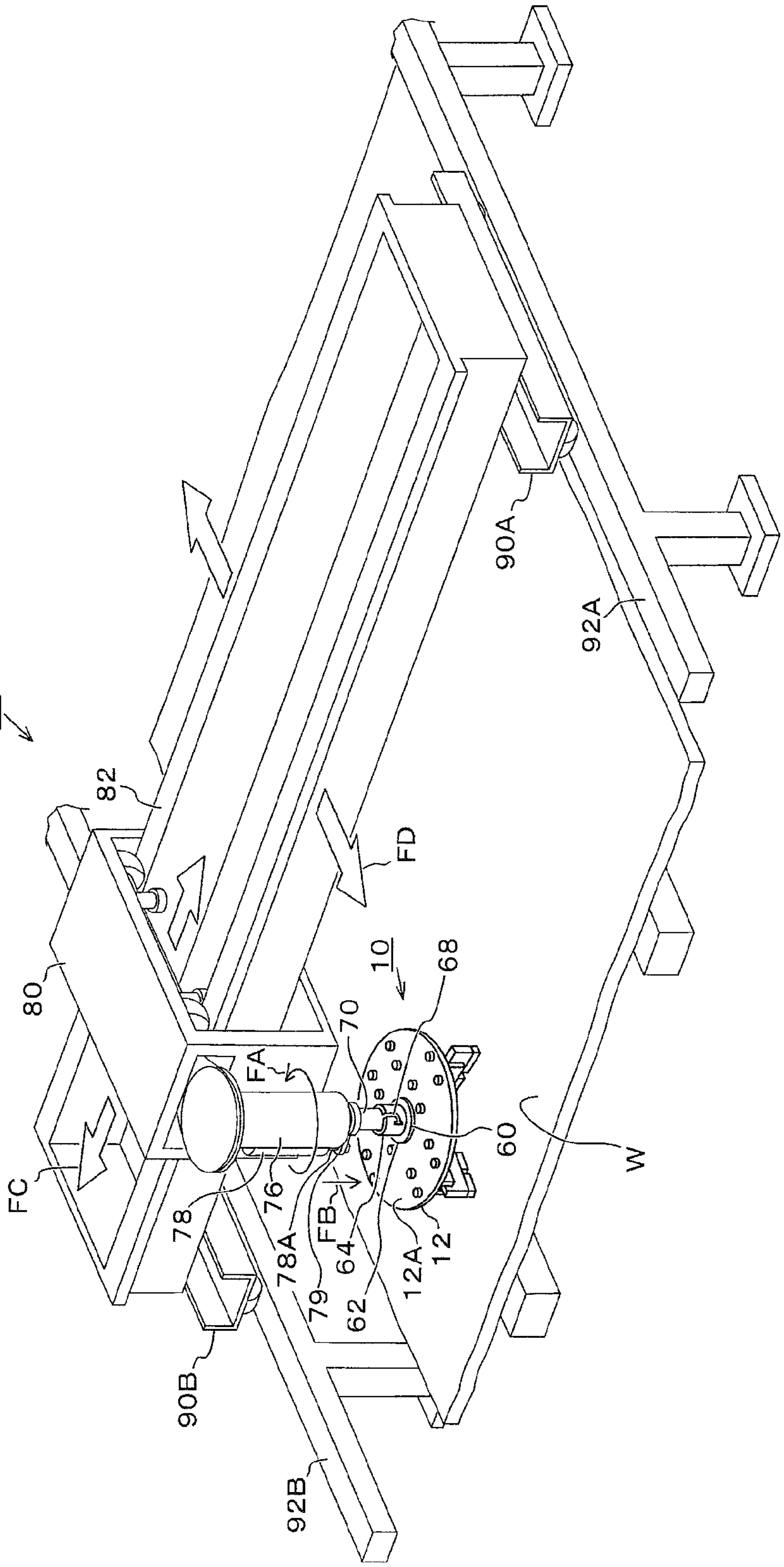
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82
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60
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12
90A
92A
90B
92B

Fig.1

Fig.2 (A)

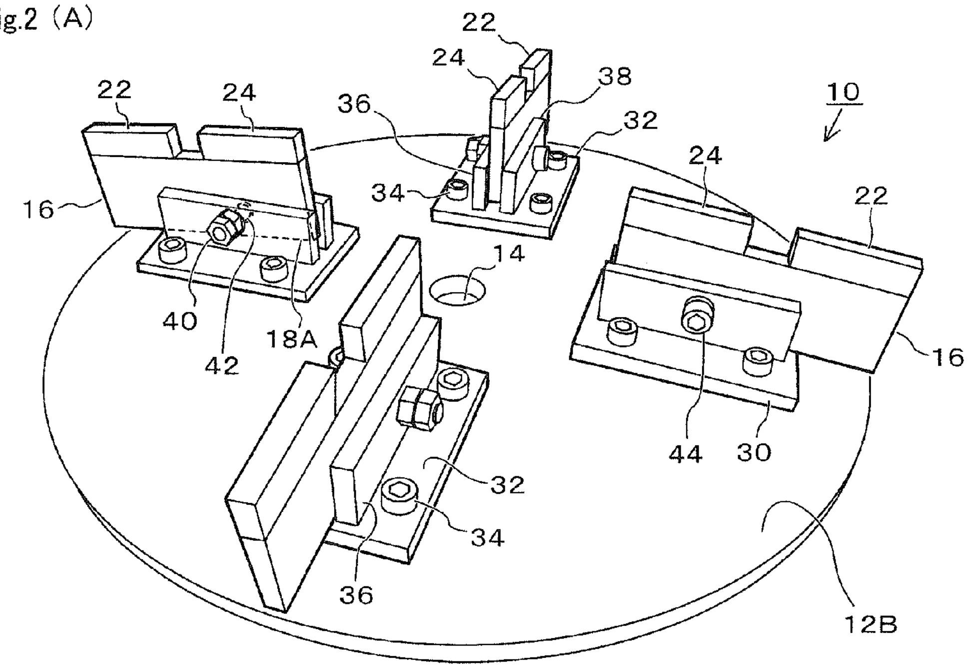


Fig.2 (B)

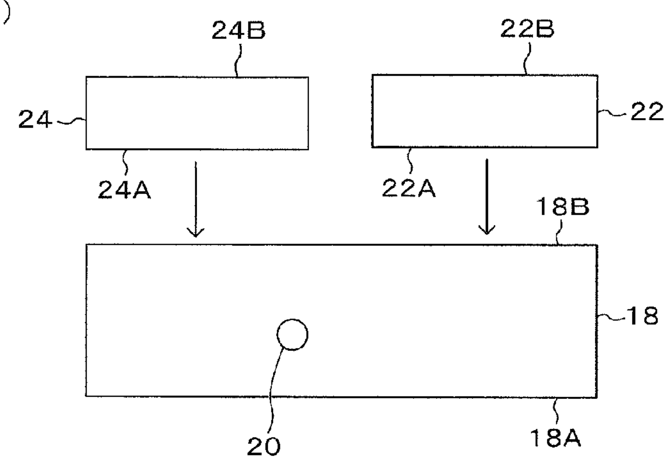


Fig.2 (C)

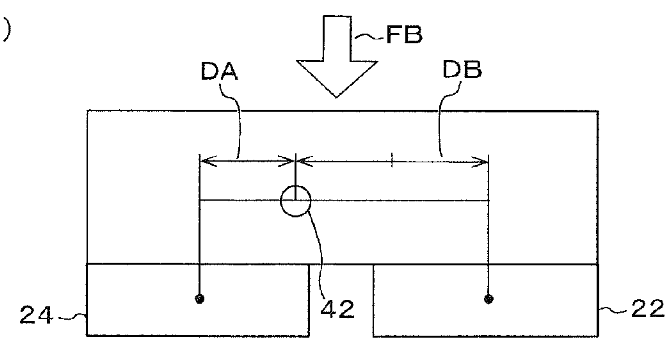
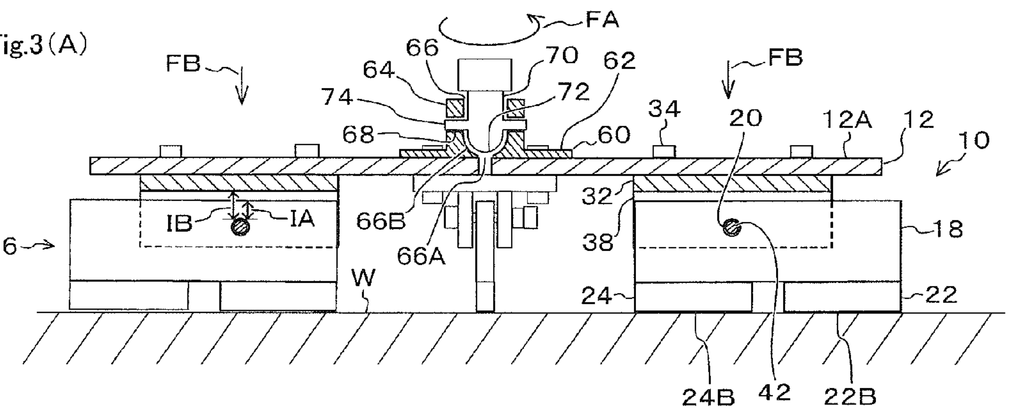


Fig.3(A)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12
10
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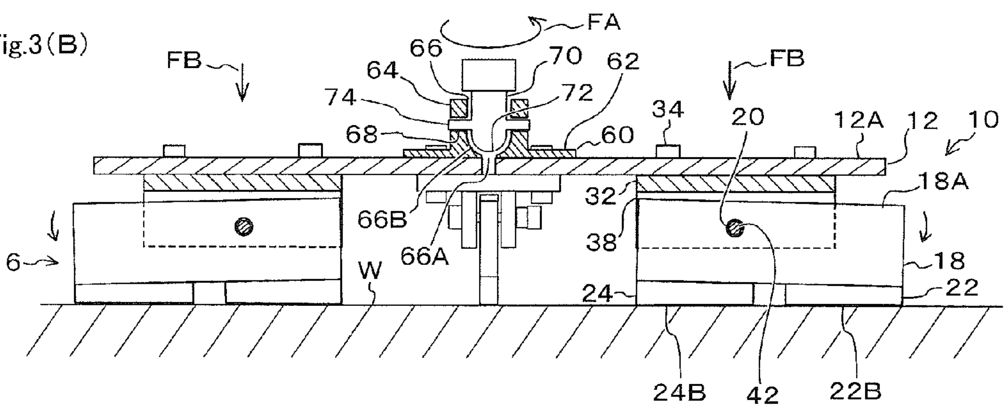
16
38
66A
W
24
22
24B
42
22B

Fig.3(B)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12
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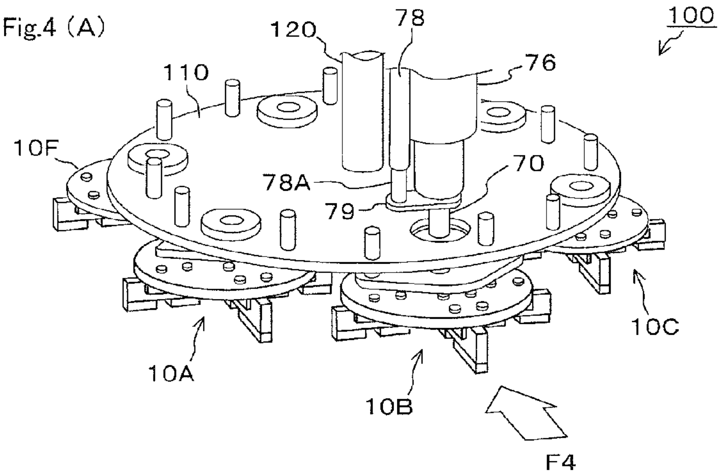
22B

Fig.4 (A)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10C
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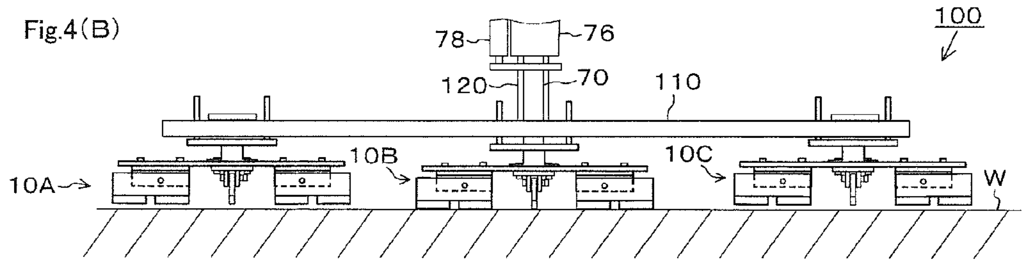
10B
F4

Fig.4(B)


100
78
76
120
70
110
10A
10B
10C
W

GRINDER AND GRINDING MACHINE

TECHNICAL FIELD

The present invention relates to a grinder and a grinding machine, specifically, to uniformity of grinding when grinding stone chips abrade and uniformity of the abrasion amounts of the grinding stone chips.

BACKGROUND ART

When grinding a stone material, the surface of the stone material as a grinding workpiece is not perfectly flat, and in a narrow sense includes slopes, undulations, and curvatures. A grinding machine is structured to enable a grinder to which grinding stone chips are attached to tilt with respect to the grinding workpiece, so that even if the stone material surface includes slopes, etc., it can be excellently ground. However, the circumferential velocity differs between the outer peripheral side and the inner peripheral side of the rotary disk, so that the movement amount per 360-degree rotation of the disk is larger on the outer peripheral side. Therefore, the degree of abrasion of the grinding stone chip on the outer peripheral side is higher than that of the grinding stone chip on the inner peripheral side, so that the grinding stone chip on the outer peripheral side cannot come into contact with the workpiece.

On the other hand, for example, in Patent Document 1 described below, by increasing the number of grinding stone chips on the outer peripheral side of the rotary disk to be larger than the number of grinding stone chips on the inner peripheral side of the rotary disk, the degrees of abrasion are substantially made uniform. In Patent Document 2 described below, by forming the grinding surfaces of the grinding chips so that their widths in the circumferential direction become narrower toward the rotary shaft core side, the abrasion amounts are made uniform.

PRIOR ART DOCUMENTS

Patent Documents

Patent Document 1: Japanese Utility Model Registration No. 3072378

Patent Document 2: Japanese Published Unexamined Patent Application No. H10-76470

SUMMARY OF THE INVENTION

Problem to be Solved by the Invention

However, each of the techniques described in Patent Document 1 and Patent Document 2 described above has a problem in that the increase in the amount of grinding stones on the outer peripheral side causes all of the grinding stones to nearly uniformly abrade, so that the weight of the entire grinder increases.

The present invention was made in view of the above-described circumstances, and an object thereof is to provide a grinder and a grinding device capable of nearly uniformly coming into contact with a workpiece and grinding it even if grinding stone chips abrade. Another object of the present invention is to provide a grinder and a grinding machine capable of making uniform abrasion amounts of grinding stone chips.

Means for Solving the Problem

A grinder according to the present invention includes a substantially discoid disk that is rotatable and pressed to a workpiece, a plurality of grinding bodies that are provided on one principal surface of the disk so as to cross the circumferential direction of the disk and have grinding stone chips on the side come into contact with the workpiece, and support means that support the grinding bodies so that the grinding stone chips swing with respect to the principal surface, and the support means support the grinding bodies at positions at which abrasion amounts of the grinding stone chips are made uniform when the disk is rotated while being pressed to the workpiece by supporting the grinding bodies at positions deviated to the inner peripheral side from the centers in the longitudinal directions of the grinding bodies so as to make a pressure to be applied to the grinding stone chip on the outer peripheral side of the disk smaller than a pressure to be applied to the grinding stone chip on the inner peripheral side of the disk.

According to one of main embodiments, the grinding bodies are disposed radially on the one principal surface.

A grinding device according to the present invention includes either of the grinders described above, a rotary shaft to which the grinder is removably attached, a driving means for rotatively driving the rotary shaft, and a pressurizing means for pressing the rotary shaft to the workpiece side. According to one of the main embodiments, the grinder is attached to the rotary shaft so that the one principal surface follows a to-be-machined surface of the workpiece. According to another embodiment, a movement mechanism that moves at least one of the grinder and the workpiece is provided to make the grinder and the workpiece movable relative to each other. The above-described and other objects, features, and advantages of the present invention will become clear from the following detailed description and accompanying drawings.

Effects of the Invention

According to the present invention, on one principal surface of a substantially discoid disk that is pressed to a workpiece, a plurality of grinding bodies are provided so as to cross the circumferential direction of the disk, and the grinding bodies are supported by support means so that the grinding stone chips swing with respect to the principal surface. In this case, the support means support the grinding bodies at positions deviated to the inner peripheral side from the centers in the longitudinal direction of the grinding bodies so that a pressure to be applied to the grinding stone chip on the outer peripheral side of the disk becomes smaller than a pressure to be applied to the grinding stone chip on the inner peripheral side of the disk. Accordingly, when the disk is rotated while being pressed to the workpiece, the grinding bodies can be supported at positions at which the abrasion amounts of the grinding stone chips are made uniform. In addition, even if the grinding stone chips abrade, they nearly uniformly come into contact with the workpiece, and easily follow the surface of the workpiece, so that uniform grinding is realized.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a view showing an entire constitution of a grinding machine according to Example 1 of the present invention.

FIGS. **2**(A)-**2**(C) are drawings showing a grinder according to Example 1, wherein FIG. **2**(A) is a perspective view of the grinder from the surface on the grinding body side, FIG. **2**(B) is a diagram showing a method for fixing grinding stone chips, and FIG. **2**(C) is an explanatory view showing support positions of the grinding bodies.

FIG. **3**(A) and FIG. **3**(B) are side views showing operation of the Example 1.

FIG. **4**(A) is an external perspective view showing an essential portion of another example of the present invention, and FIG. **4**(B) is a side view from the arrow F**4** in FIG. **4**(A).

BEST MODE FOR CARRYING OUT THE INVENTION

Hereinafter, best modes for carrying out the present invention are described in detail based on examples.

Example 1

First, Example 1 of the present invention is described with reference to FIG. **1** to FIG. **3**. FIG. **1** is an external perspective view showing an entire constitution of a grinding machine according to the present example. As shown in FIG. **1**, a grinding machine **50** according to the present example is for grinding the surface of a workpiece W such as a stone material, and the present example is an example of a single-spindle type. The grinding machine **50** has a grinder **10** attached to the tip end of a rotary shaft **70** provided on a spindle **76**, and the grinder **10** is rotatable as shown by the arrow FA in the same drawing. Lateral to the spindle **76**, a hydraulic cylinder **78** is provided as the pressurizing means for pressing the rotary shaft **70** to the workpiece W side (refer to the arrow FB). The rod **78**A of the hydraulic cylinder **78** is joined to the rotary shaft **70** by a joint member **79**. Further, the spindle **76** is an automatic traveling type movable along the surface of the workpiece W.

For example, a slider **80** to which the spindle **76** is attached can reciprocate in the direction shown by the arrow FC in FIG. **1** along a guide **82** disposed above the workpiece W. Both ends of the guide **82** are supported by sliders **90**A and **90**B, and these sliders **90**A and **90**B can reciprocate in the direction shown by the arrow FD in FIG. **1** along a pair of rails **92**A and **92**B disposed in a direction orthogonal to the guide **82**. The rotary drive mechanism of the rotary shaft **70**, the pressurizing mechanism using the hydraulic cylinder **78**, and the reciprocating mechanism of the sliders **80**, **90**A, and **90**B are known, so that descriptions of these are omitted.

Next, the grinder **10** is described. FIG. **2** are drawings showing a grinder according to the present example, and FIG. **2**(A) is a perspective view of the grinder from the surface on a grinding body **16** side, FIG. **2**(B) is a diagram showing a method for fixing grinding stone chips, and FIG. **2**(C) is an explanatory view showing support positions of the grinding bodies. The grinder **10** consists of a substantially discoid disk **12**, a plurality of grinding bodies **16** provided on one principal surface **12**B of the disk **12**, and support bodies **30** that support the grinding bodies **16** swingably. At the center of the disk **12**, a through hole **14** is formed.

The grinding body **16** is constituted by providing grinding stone chips **22** and **24** at an appropriate interval on the upper principal surface **18**B of a rectangular plate **18** in the example shown in the drawings. In the example shown in the drawings, four grinding bodies **16** are provided radially. One grinding stone chip **22** is positioned on the outer peripheral side of the disk **12**, and the other grinding chip **24** is positioned on the inner peripheral side of the disk **12**. As the grinding stone chips **22** and **24**, known grinding chips, for example, diamond chips, etc., can be used. These grinding stone chips **22** and **24** are attached to both sides of the plate principal surface **18**B by, for example, brazing the lower principal surfaces **22**A and **24**A of the grinding stone chips **22** and **24**, as shown in FIG. **2**(B). In the plate **18**, at a position closer to the inner periphery than the center in the longitudinal direction, a through hole **20** is formed. “Upper” and “lower” referred to herein mean upper and lower sides in the state shown in FIG. **2**(A) and FIG. **2**(B), and in the state shown in FIG. **1** and FIG. **3**, the upper and lower sides are inverted.

The support body **30** that supports the grinding body **16** includes, as shown in FIG. **2**(A), a tabular attaching plate **32** to be fixed to the principal surface **12**B of the disk **12** by fixtures **34** such as bolts, and a pair of support plates **36** and **38** fixed so as to become orthogonal to the attaching plate **32**. These support plates **36** and **38** are disposed at an appropriate interval so as to sandwich the plate **18** of the grinding body **16**. The support plates **36** and **38** are fixed to the attaching plate **32** by, for example, welding, etc. In these support plates **36** and **39**, a through hole not shown through which a shaft portion **42** of a bolt **40** for supporting the grinding body **16** penetrates is formed.

The grinding body **16** is sandwiched between the pair of support plates **36** and **38** of the support body **30**, the positions of the through hole **20** of the grinding body **16** and the through holes not shown of the support plates **36** and **38** are aligned with each other, and as shown in FIG. **2**(A), the grinding body **16** is fixed by the bolt **40** and nut **44**. Accordingly, the grinding body **16** is supported turnably by the shaft portion **42** of the bolt **40**. Here, by setting the distance IA (refer to FIG. **3**(A)) from the principal surface **18**A of the plate **18** to the shaft portion **42** to be shorter than the distance IB from the attaching plate **32** to the shaft portion **42**, the grinding body **16** becomes swingable with respect to the principal surface **12**B of the disk **12**.

The support positions of the grinding bodies **16** are described with reference to FIG. **2**(C). FIG. **2**(C) corresponds to a state where the upper and lower sides in FIG. **2**(B) are inverted. If the penetrating position of the shaft portion **42** is at the center position in the longitudinal direction of the plate **18**, when the rotary shaft **70** is pressed to the workpiece W by the hydraulic cylinder **78**, the pressures to be applied to the inner peripheral side and the outer peripheral side of the shaft portion **42** as a boundary become equal to each other. In this case, as in the background art, the abrasion amount of the grinding stone chip **22** on the outer peripheral side on which a peripheral velocity is higher increases, and this grinding stone chip cannot come into contact with the workpiece W. Therefore, in the present invention, the abrasion amounts of the grinding stone chips **22** and **24** on the inner peripheral side and the outer peripheral side of the shaft portion **42** as a boundary are made nearly uniform by changing the pressures to be applied to the grinding stone chips **22** and **24**. That is, by deviating the shaft portion **42** from the center in the longitudinal direction of the plate **18** toward the inner periphery, the pressure to be applied to the inner peripheral side becomes higher than the pressure to be applied to the outer peripheral side, and the grinding stone chip **24** on the inner peripheral side and the grinding stone chip **22** on the outer peripheral side nearly uniformly abrade.

In a more detailed description, as shown in FIG. **2**(C), the distance from the point of intersection between a vertical line passing through the center of the grinding stone chip **24** on the inner peripheral side and a horizontal line passing through the center of the shaft portion **42** to the center of the shaft portion **42** is defined as DA, and the distance from the point of intersection between a vertical line passing through the center of the grinding stone chip **22** on the outer peripheral side and the horizontal line to the center of the shaft portion **42** is defined as DB. In the present example, DB is set to be twice as large as DA so that the pressure to be applied to the grinding stone chip **24** on the inner peripheral side becomes twice as high as the pressure to be applied to the grinding stone chip **22** on the outer peripheral side. With this constitution, the abrasion amounts on the outer peripheral side and the inner peripheral side become nearly uniform. Even if the abrasion amounts on the outer peripheral side and the inner peripheral side become different, by swinging of the grinding body **16** around the shaft portion **42** as a fulcrum, the entireties of the principal surfaces **22**B and **24**B of the grinding stone chips **22** and **24** always come into contact with the surface of the workpiece W, so that the workpiece W can be nearly uniformly ground.

The grinder **10** constituted as described above is removably attached to the rotary shaft **70** via a joint member **60** provided on the other principal surface **12**A of the disk **12** as shown in FIG. **1**. The joint member **60** includes, as shown in FIG. **3**(A), a substantially circular fixed plate **62** and a substantially cylindrical cylinder portion **64**. The cylinder portion **64** has a groove **68** on the side surface as shown in FIG. **1**. On the lower side of the hollow portion **66** of the cylinder portion **64**, a through hole **66**A and a curved surface portion **66**B are formed. On the other hand, the rotary shaft **70** has a tip end **72** formed to be curved, and a pin **74** projecting in a radial direction on the outer peripheral surface. By engaging this pin **74** in the groove **68** of the cylinder portion **64**, the grinder **10** is removably attached to the rotary shaft **70**.

Although not shown, the rotary shaft **70** is hollow to allow cooling water to pass through, and this cooling water passes through the through hole **66**A of the joint member **60** and the through hole **14** of the disk **12** and cools the machined portion. The outer diameter of the rotary shaft **70** is set to be slightly smaller than the inner diameter of the cylinder portion **64** and the cylinder portion **64** can tilt with respect to the rotary shaft **70**. Therefore, the grinder **10** can tilt with respect to the rotary shaft **70** and follow the surface shape of the workpiece W. The method for joining this grinder **10** and the rotary shaft **70** is known.

Next, operation of the present example is described with reference to FIG. **3** as well. As shown in FIG. **3**(A), the grinder **10** is attached to the rotary shaft **70**, and the grinding stone chips **22** and **24** are brought into contact with and pressed against the surface of the workpiece W by driving of the hydraulic cylinder **78**. In this pressed state, the grinder **10** is rotated via the rotary shaft **70** to perform grinding. At this time, as described above, the position of the shaft portion **42** supporting the grinding body **16** is set on the inner peripheral side, so that even when grinding progresses, the abrasion amounts of the grinding stone chip **22** on the outer peripheral side and the grinding stone chip **24** on the inner peripheral side become substantially equal to each other, and nearly uniform grinding can be performed. Even if a slight difference occurs in grinding amount, in the present example, the grinding body **16** is supported swingably with respect to the disk principal surface **12**B by the support body **30**. Therefore, the grinding body **16** swings around the shaft portion **42** as a fulcrum as shown by the arrow in FIG. **3**(B), and the entireties of the principal surfaces **22**B and **24**B of the grinding stone chips **22** and **24** nearly uniformly come into contact with the workpiece W. At the start of grinding of the workpiece W, surface roughness of the workpiece W is great, however, since the grinder **10** is structured so as to easily follow the workpiece W by tilting with respect to the rotary shaft **70** and the grinding bodies **16** swing with respect to the disk **12**, the grinder **10** still more easily follows the workpiece W.

Thus, according to Example 1, the following effects are obtained.

(1) A plurality of grinding bodies **16** are provided radially on one principal surface **12**B of the substantially discoid rotatable disk **12**, and the positions of the grinding bodies **16** close to the inner periphery are supported by the support bodies **30**. Therefore, when the disk **12** is rotated while being pressed to the workpiece W, the grinding stone chips **22** and **24** of the grinding bodies **16** nearly uniformly abrade.

(2) The grinding bodies **16** are supported swingably by the shaft portions **42**, so that even if the abrasion amounts differ between the grinding stone chip **22** on the outer peripheral side and the grinding stone chip **24** on the inner peripheral side, the entireties of the principal surfaces **22**B and **24**B of the grinding stone chips **22** and **24** swing so as to come into contact with the workpiece W. As a result, even if the grinding stone chip abrasion amounts differ between the outer peripheral side and the inner peripheral side, nearly uniform grinding can be performed.

(3) The grinder **10** is attached so as to be tiltable with respect to the rotary shaft **70**, so that grinding along the shape of the workpiece W can be performed.

(4) The grinding bodies **16** can swing with respect to the disk **12**, so that they more easily follow the shape of the workpiece W.

The present invention is not limited to the example described above, and can be variously modified without departing from the spirit of the present invention. For example, the present invention also includes the following.

(1) The shapes, dimensions, and materials shown in the example are just examples, and can be changed as appropriate. For example, in the example described above, the plate **18** to which the grinding stone chips **22** and **24** are attached is substantially rectangular, however, as long as swinging is not obstructed, it can be changed in such a manner that the corners on both ends of the principal surface **18**A of the plate **18** are rounded.

(2) In the example described above, four grinding bodies **16** are provided radially, however, the number and positions of the grinding bodies **16** can be changed as appropriate. For example, even if the grinding bodies **16** are not provided perfectly radially, the same effects as those of Example 1 described above can be obtained as long as the grinding bodies are disposed so as to cross the circumferential direction of the disk **12**.

(3) The support body **30** shown in the example described above is also an example, and the design can be changed as appropriate within the scope in which the same effects are obtained. For example, the lengths of DA and DB shown in FIG. **2**(C) are also an example, and it is also possible that the support body **30** supports the grinding body **16** swingably around a portion near the center of the grinding body **16** as a fulcrum. In this case, the pressures to be applied to the inner peripheral side and the outer peripheral side of the shaft portion **42** as a boundary are equal to each other, and due to swinging of the grinding body **16**, even if the abrasion amounts of the grinding stone chips **22** and **24** become different, the grinding stone chips **22** and **24** can be nearly uniformly brought into contact with the workpiece W.

(4) The joint mechanism between the grinder **10** and the rotary shaft **70** shown in the example described above is also an example, and various known mechanisms can also be used. In the example described above, the grinder **10** is

joined so as to be tiltable with respect to the rotary shaft **70**, and this is also an example, and the grinder may be joined so as not to tilt.

(5) In the grinding machine **50** according to the example described above, the grinder **10** moves with respect to the workpiece W, and this is also an example, and it is also possible that the workpiece W side moves, or both of the grinder **10** and the workpiece W are movable.

(6) In the example described above, grinding of the upper surface of the planar workpiece W is described by way of example, and this is also an example, and it is also possible that, according to the shape, etc., of the workpiece W, the disk **12** of the grinder **10** is supported vertically to grind the side surface or the like of the workpiece W.

(7) In the example described above, the grinding stone chips **22** and **24** are attached at an appropriate interval to the plate principal surface **18**B, and this is also an example, and it is also allowed that three or more chips are attached, or one chip is provided. For example, it is also possible that setting is made to make different the number of chips according to roughness of the grinding stones.

(8) In the example described above, a single-spindle type grinding machine is shown, and this is also an example, and the grinder of the present invention is also applicable to multi-spindle type grinding machines. For example, like a grinding machine **100** shown in FIG. **4**(A) and FIG. **4**(B), a constitution can also be adopted in which a plurality of grinders **10**A to **10**F with different grit numbers are attached to an attaching disk **110**, and according to a workpiece W, the grinder to be connected to the rotary shaft **70** is automatically changed. The attaching disk **110** itself is made rotatable by a rotary shaft **120** provided in nearly the center, and is driven only when the grinder to be connected to the rotary shaft **70** is changed among the grinders **10**A to **10**F.

(9) A workpiece to be ground according to the present invention is preferably a stone material by way of example, however, without limiting to this, the present invention is also applicable to, for example, an artificial stonework.

INDUSTRIAL APPLICABILITY

According to the present invention, on one of the principal surfaces of a substantially discoid disk that is rotatable and pressed to a workpiece, a plurality of grinding bodies are provided so as to cross the circumferential direction of the disk, and the grinding bodies are supported so that the grinding stone chips swing with respect to the principal surface. At this time, the support means support the grinding bodies at positions deviated to the inner peripheral side from the centers in the longitudinal direction of the grinding bodies so that the pressure to be applied to the grinding stone chip on the outer peripheral side of the disk becomes smaller than the pressure to be applied to the grinding stone chip on the inner peripheral side of the disk. Accordingly, when the disk is rotated while being pressed to the workpiece, the grinding bodies are supported at positions at which the abrasion amounts of the grinding stone chips become uniform, and even if the grinding stone chips abrade, they nearly uniformly come into contact with the workpiece and easily follow the surface of the workpiece. Therefore, the present invention is applicable to uses of grinders and grinding machines.

DESCRIPTION OF REFERENCE SYMBOLS

10, **10**A to **10**F: grinder
12: disk
12A, **12**B: principal surface
14: through hole
16: grinding body
18: plate
18A, **18**B: principal surface
20: through hole
22, **24**: grinding stone chip
22A, **22**B, **24**A, **24**B: principal surface
30: support body
32: attaching plate
34: fixture
36, **38**: support plate
40: bolt
42: shaft portion
44: nut
50: grinding machine
60: joint member
62: fixed plate
64: cylinder portion
66: hollow portion
66A: through hole
66B: curved surface portion
68: groove
70: rotary shaft
72: tip end
74: pin
76: spindle
78: hydraulic cylinder
78A: rod
79: joint member
80: slider
82: guide
90A, **90**B: slider
92A, **92**B: rail
100: grinding machine
110: attaching disk
W: workpiece

What is claimed is:

1. A grinder comprising:

a substantially discoid disk that is rotatable around a rotation axis of the disk and is adapted to be pressed to a workpiece;

a plurality of grinding bodies provided on one principal surface of the disk so that the plurality of grinding bodies extends radially outwardly from the rotation axis of the disk, each of the plurality of grinding bodies having a grinding stone chip on a side contacting the workpiece; and

support devices attached to the disk, each supporting device supporting the each of the plurality of grinding bodies so that the grinding stone chip swings with respect to the principal surface,

wherein each of the support devices has a supporting point supporting the each of the plurality of grinding bodies so that an abrasion amount of the grinding stone chip is made uniform when the disk is rotated while being pressed to the workpiece, the supporting point being deviated to an inner peripheral side from a center in a longitudinal direction of each the plurality of grinding bodies so that a pressure to be applied to the grinding stone chip on an outer peripheral side of the disk becomes smaller than a pressure to be applied to the grinding stone chip on an inner peripheral side of the disk.

2. The grinder according to claim **1**, wherein the plurality of grinding bodies is disposed at an equal distance from the rotation axis of the disk.

3. A grinding device comprising:

a grinder grinding a workpiece;

a rotary shaft to which the grinder is removably attached;

a driving device for rotatively driving the rotary shaft; and

a pressurizing device for pressing the rotary shaft to the workpiece side,

wherein the grinder comprises

a substantially discoid disk that is rotatable around the rotary shaft and is adapted to be pressed to the workpiece,

a plurality of grinding bodies provided on one principal surface of the disk so that the plurality of grinding bodies extends radially outwardly from the rotary shaft, each of the plurality of grinding bodies having a grinding stone chip on a side contacting the workpiece; and

support devices attached to the disk, each support device supporting the each of the plurality of grinding bodies so that the grinding stone chip swings with respect to the principal surface, and

wherein each of the support devices has a supporting point supporting the each of the plurality of grinding bodies so that an abrasion amount of the grinding stone chip is made uniform when the disk is rotated while being pressed to the workpiece, the supporting point being deviated to an inner peripheral side from a center in a longitudinal direction of each the plurality of grinding bodies so that a pressure to be applied to the grinding stone chip on an outer peripheral side of the disk becomes smaller than a pressure to be applied to the grinding stone chip on an inner peripheral side of the disk.

4. A grinding device comprising:

a grinder grinding a workpiece;

a rotary shaft to which the grinder is removably attached;

a driving device for rotatively driving the rotary shaft; and

a pressurizing device for pressing the rotary shaft to the workpiece side,

wherein the grinder comprises

a substantially discoid disk that is rotatable around the rotary shaft and is adapted to be pressed to the workpiece,

a plurality of grinding bodies provided on one principal surface of the disk so that the plurality of grinding bodies extends radially outwardly from the rotary shaft and equally spaced from the rotary shaft, each of the plurality of grinding bodies having a grinding stone chip on a side contacting the workpiece; and

support devices attached to the disk, each support device supporting the each of the plurality of grinding bodies so that the grinding stone chip swings with respect to the principal surface, and

wherein each of the support devices has a supporting point supporting the each of the plurality of grinding bodies so that an abrasion amount of the grinding stone chip is made uniform when the disk is rotated while being pressed to the workpiece, the supporting point being deviated to an inner peripheral side from a center in a longitudinal direction of each the plurality of grinding bodies so that a pressure to be applied to the grinding stone chip on an outer peripheral side of the disk becomes smaller than a pressure to be applied to the grinding stone chip on an inner peripheral side of the disk.

5. The grinding device according to claim **3**, wherein the grinder is attached to the rotary shaft so that the one principal surface follows a surface, to be machined, of the workpiece.

6. The grinding device according to claim **4**, wherein the grinder is attached to the rotary shaft so that the one principal surface follows a surface, to be machined, of the workpiece.

7. The grinding device according to claim **3**, further comprising a movement mechanism that moves at least one of the grinder and the workpiece relative to another of the grinder and the workpiece.

8. The grinding device according to claim **4**, further comprising a movement mechanism that moves at least one of the grinder and the workpiece relative to another of the grinder and the workpiece.

9. The grinding device according to claim **5**, further comprising a movement mechanism that moves at least one of the grinder and the workpiece relative to another of the grinder and the workpiece.

10. The grinding device according to claim **6**, further comprising a movement mechanism that moves at least one of the grinder and the workpiece relative to another of the grinder and the workpiece.

11. The grinding device according to claim **1**, wherein the each of the plurality of grinding bodies has a shaft portion connecting the each of the plurality of grinding bodies and the each of the support devices, and

a distance of a horizontal line horizontal to each of the longitudinal directions of the each of the plurality of grinding bodies extending from a center of the shaft portion to a vertical line vertical to the each of the longitudinal directions of the each of the plurality of grinding bodies extending from a center of the grinding stone chip on the outer peripheral side of the disk is twice as much long as a distance of the horizontal line horizontal to the each of the longitudinal directions of the each of the plurality of grinding bodies extending from the center of the shaft portion to a vertical line vertical to the each of the longitudinal directions of the each of the plurality of grinding bodies extending from a center of the grinding stone chip on the inner peripheral side of the disk.

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